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Strutting Sounds and Strutting Posturing of Two Utah Sage Grouse Populations

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Research Summary

Sound and video tape recordings and still pictures were taken of strutting sage grouse (*Centrocercus urophasianus*) from two different populations. The two populations were located in the Strawberry Valley and Parker Mountains (Awapa Plateau). Analysis of sound

recordings by Pro Tools software for the Macintosh Quadra 950 computer, revealed 16 elements in the strutting sequence. These elements were common for both populations regardless of the male's status within a population. Previous workers using sonagrams have described eight elements. No significant difference in length of strutting sequence between the two populations was detected. In fact, length of strutting varied greatly among multistrutting sequences of the same bird. Number of steps taken during the strutting sequences was similar for the two populations. Analysis of video tape and still pictures revealed strong similarity of posturing between the two populations. The conclusion drawn from this study is that the Parker Mountains population would be suitable in terms of breeding display behavior to augment the Strawberry Valley population. Sexual compatibility would need to be determined in a future study.

Acknowledgments

We thank the Journal of Behavioral Ecology and Sociobiology for permitting us to reproduce and publish the previously published sonagram of figure 2. We thank the Utah Division of Wildlife Resources and the Heber Ranger District of the Uinta National Forest for their encouragement and cooperation. Special thanks goes to Dr. Warren P. Clary, Dr. David L. Nelson, Mr. Bruce C. Giunta, and Mr. Dean L. Mitchell for furnishing peer reviews for this manuscript.

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Strutting Sounds and Strutting Posturing of Two Utah Sage Grouse Populations

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There are 92 percent fewer sage grouse in the Strawberry Valley of central Utah today than in 1938 (Welch and others 1990). A study conducted by Griner (1939) in the late 1930's estimated the Strawberry Valley sage grouse population to be 3,500 birds. Today, we estimate the population to be about 290 birds (population estimates based on the method described by Smith and Greenwood 1983). A reduction of about 3,210 birds. Our population estimates for the past 7 years show the population has stabilized at the current high of 290 birds. In addition to low number, our surveys have found only one active strutting ground in the valley. Unfortunately, this strutting ground will be flooded when the new enlarged Strawberry Reservoir is filled. So the need of augmenting the sage grouse population with compatible individuals is two-fold: expansion into previously occupied areas in the valley and the establishment of other strutting grounds.

In this study we sought to determine suitability in terms of breeding display behavior of the Parker Mountains population of sage grouse (*Centrocercus urophasianus*) for augmenting the Strawberry Valley population. Both populations occupy similar elevations (8,000 ft) and spring, summer, and fall habitats. These habitats are mountain big sagebrush (*Artemisia tridentata* spp. *vaseyana*)-grass mix and aspen (*Populus tremuloides*)-mountain big sagebrush-grass mix.

Differences in strutting sounds, posturing, and coloration have been reported among populations of sage grouse (Barber 1991; Drew 1994). These differences could create breeding barriers between populations (Barber 1991; Drew 1994). The more similar the strutting sounds, posturing, and coloration between the two populations, the higher the probability of successful augmentation.

We hypothesize that there is no significant difference in strutting sounds, posturing, and coloration between the Strawberry Valley and Parker Mountains populations. If true, these reasons alone should not preclude augmentative efforts from one population to the other.

Strutting Ground and Strutting Ground Organization

One characteristic of strutting grounds is their traditional location (Autenrieth 1986; Patterson 1952; Scott 1942; Wallestad 1975; Wiley 1978). The strutting sage grouse return to the same spot year after year. Strutting grounds are open areas surrounded by big sagebrush (*Artemisia tridentata*) cover (Autenrieth 1986; Roberson 1986; Scott 1942). Size varies from less than 1 acre to 40 acres. Big sagebrush plants surrounding strutting grounds are used for food, loafing, and cover. Located on the strutting grounds are, depending on size, one or more mating centers. Three distinguishable bird behavioral characteristics help to locate the mating centers; females move in from surrounding big sagebrush cover and congregate at the center. The center is vigorously defended by a single male bird called the master cock, and occurrence of actual mating (Autenrieth 1986; Scott 1942; Wiley 1978). Around the mating center are two to three groups of strutting males. These groups in hierarchical descending order from the mating center are: dominant cocks, guard cocks, and cocks strutting in the big sagebrush cover surrounding the strutting grounds that we dubbed "outsiders" (Patterson 1952; Scott 1942; Wiley 1978). In general, as the distance increases from the mating center, the cocks become younger and smaller (Scott 1942; Wiley 1978). The mating center is small, about 900 square feet, and is found in the same place year after year unless disturbed (Wiley 1978).

Methods

The Strawberry Valley strutting ground is in the southeast quarter of section 2, range 11 west, township 4 south (Uinta Special Meridian). The Parker Mountains strutting ground is in the northwest quarter of section 26, range 1 east, township 28 south (Salt Lake Meridian). Two days before recording strutting

sounds and posturing, the mating centers where the master cock struts were located for each strutting ground. A tent was pitched near the strutting grounds about 75 to 125 feet from the mating center.

Strutting sounds were recorded using a Marantz PM0430 3-head cassette deck without noise reduction. Three AKG CK 9-element microphones with 351 preamps were used. These were fed to a BAM 12v mixer which allowed us to switch among the microphones. Each microphone was positioned so that its range would be in the center of the territory of a single bird. For a single recording event we were able to record the sounds of the master cock, a dominant cock, and a guard cock. On a second recording event we positioned the microphone aimed at a guard cock so it would record the sounds of a strutting "outsider" cock. Recordings then were made of the master cock, a dominant cock, a guard cock, and an outsider cock for the Strawberry Valley and Parker Mountains strutting grounds.

Recordings were analyzed by Pro Tool software for the Macintosh Quadra 950 computer. This system produces a visual display of the strutting sounds, known as a sound print. These sound prints can be used to compare patterns of sounds among cocks on the same strutting ground, different recordings of the same cocks, or cocks on different strutting grounds. In addition, this system allows for slow playback for actual timing of the various sound elements in the sequence and the nature of the sound. Populations means were determined for length of strutting sequence. These means were compared by using a T-test with unpaired observations ($p \leq 0.05$).

A Sony Handycam PRO CCD video 8 was used to record the posturing of various males from both strutting grounds. Still pictures were taken with a 35 mm single reflex camera with a 400 mm telephoto lens. Also, the number of steps taken during the strut was determined by use of the video tape. Populations means were determined and compared by using a T-test with unpaired observations ($p \leq 0.05$).

Results and Discussion

We found 16 sound elements in the strutting sequence of all cocks regardless of status or population. These 16 elements are: first wing swish; first resonance sound; second wing swish; second resonance sound; first whooo; second whooo; third whooo; first pop; third resonance sound; second pop; fourth resonance sound; first snore; second snore; first flop; second flop; third flop. These sound elements are illustrated in figure 1.

Hjorth (1970), Wiley (1978), Gibson and Bradbury (1985), and Barber (1991), reported finding eight

sound elements in the strutting sequence. These workers recognized, through sonagrams, the following sound sequence: first wing swish; second wing swish; first hoot; second hoot; third hoot; first pop; whistle; and second pop. These eight sound elements are illustrated in figure 2.

The differences between our study and those of Hjorth (1970), Wiley (1978), Gibson and Bradbury (1985), and Barber (1991) are resonating sounds after the first and second wing swishes, after the second pop, and a five element snore some 2.5 to 3.0 seconds after the second pop. We described the sound between the first pop and second as a resonating sound, whereas the other researchers described the sound as a whistle. In addition, we used the term "whooo" instead of "hoot" for the three sound elements that occur before the first pop. Other workers (Barber 1991; Gibson and Bradbury 1985; Hjorth 1970; Wiley 1978) have terminated the strutting sequence of sounds after the second pop. We included the resonating sound after the second pop and the five element snore. This sound, the five element snore, is like the sound generated when air is forced passed relaxed lips. A horse makes this sound. When the snore is generated the whole body of the bird shakes slightly. Scott (1942) described this sound as a guttural belching. Hjorth (1970) and Barber (1991) have observed the same sound. Hjorth (1970) called it a snore, but Barber (1991) described it as a click in four of the populations he studied and as a cackle for the Monticello, UT, population. Neither Hjorth (1970) nor Barber (1991) included the five element snore or the resonance after the second pop as part of the strutting sequence. Because the only time sage grouse generate these six elements of sound is during the strut, we believe it is proper to include them as part of the strutting sequence.

We believe that our differences are differences in details, rather than differences among populations of the various studies, except for the Monticello, UT, birds studied by Barber (1991). Our microphones and analytical technology may have given us greater sensitivity.

All birds in our study expressed the same patterns of sounds during a strutting sequence. Barber (1991) and Drew (1994) described a population that differs in the pattern of sound elements generated in a strutting sequence. According to Drew (1991), sage grouse of the Colorado Gunnison Basin "pop their air sacs nine times in 2 seconds rather than twice." Barber (1991) reported that sage grouse located northeast of Monticello, UT, produced between 5 and 7 pops per strutting sequence. Our data supports Wiley's (1973) conclusion that sage grouse strutting display is fixed but exceptions do exist.

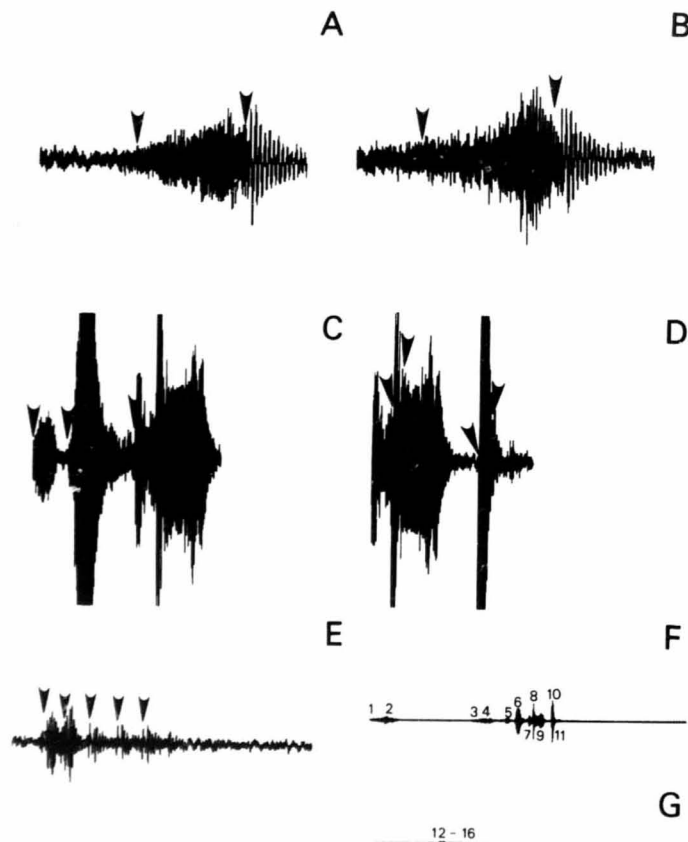


Figure 1—Strutting sage grouse sound print composed of 16 elements. These elements were common for both populations regardless of the male's status within a population. This sound print is of the master cock of the Strawberry Valley population. A—first wing swish (beginning at the 1st arrow from the left to 2nd arrow) and first resonance (2nd arrow to end); B—second wing swish (1st arrow to 2nd) and second resonance (2nd arrow to end); C—first whooo (1st arrow to 2nd), 2nd whooo (2nd arrow to 3rd), and 3rd whooo (3rd arrow to end); D—first pop (1st arrow to 2nd), third resonance (2nd arrow to 3rd), 2nd pop (3rd arrow to 4th), and fourth resonance (4th arrow to end); and E—the five element snore or "guttural belch," first snore (1st arrow), second snore (2nd arrow), first flop (3rd arrow), second flop (4th arrow), and third flop (5th arrow). F and G are representations of the same elements but at a reduced scale to show the relative positions of the 16 elements to each other. The horizontal distance between element 11 and 12 has been interrupted.

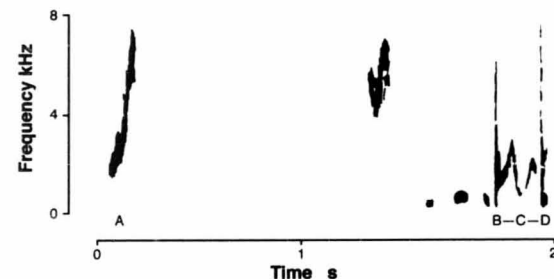


Figure 2—A reproduction of a sonogram of strutting sage grouse by Gibson and Bradbury (1985). Wide band sonogram of sounds emitted during the sage grouse strut display. Labeled components are: A—first wing swish; B—first popping sound; C—whistle; D—second popping sound.

The second whooo (element 6, fig. 1F) in the strutting sequence is the strongest of the three whoos. This observation seems to be in agreement with the sonogram of figure 2 (Gibson and Bradbury 1985). The three dot looking elements just left of the first pop (B) appear to correspond to three whoos of our sound print. The middle or second dot appears to be larger than the other two. It is the whoos, we hear first as we approach a strutting ground.

Time intervals among the 16 sound elements generated by the master Strawberry Valley cock during four strutting sequences are given in table 1. Total

length of time for the strutting sequence varied from 4.329 to 5.384 seconds or a range of 1.055 seconds for the four sequences studied. This range of 1.055 seconds for a sequence that is about 5.000 seconds long represents a large amount of variation, particularly considering that the four sequences studied were generated by the same birds within a two minute period.

Time interval comparisons among the 16 sound elements for the two populations of sage grouse are given in tables 2 and 3. Mean length of strutting sequence for the Parker Mountains population was

Table 1—Time intervals among the 16 strutting elements of the master cock of Strawberry Valley for four different strutting sequences. Data given in seconds.

	1st	2nd	3rd	4th
1st Wing swish	0.000	0.000	0.000	0.000
1st Resonance	0.361	0.183	0.633	0.446
2nd Wing swish	1.351	0.955	1.411	1.216
2nd Resonance	1.503	1.178	1.623	1.401
1st Whooo	1.712	1.326	1.774	1.565
2nd Whooo	1.826	1.426	1.874	1.697
3rd Whooo	1.998	1.571	2.006	1.747
1st Pop	2.055	1.618	2.063	1.826
3rd Resonance	2.074	1.631	2.078	1.871
2nd Pop	2.264	1.803	2.250	2.063
4th Resonance	2.321	1.834	2.273	2.096
1st Snore	5.155	4.364	4.750	4.156
2nd Snore	5.213	4.416	4.810	4.213
1st Flop	5.270	4.472	4.866	4.269
2nd Flop	5.327	4.533	4.920	4.284
3rd Flop	5.384	4.582	4.976	4.329

Table 2—Time intervals among the 16 strutting elements of the master, a dominant, a guard, and an outsider cock of the Parker Mountains. Data given in seconds. One sequence per cock class.

	Master	Dominant	Guard	Outsider
1st Wing swish	0.000	0.000	0.000	0.000
1st Resonance	0.180	0.352	0.220	0.200
2nd Wing swish	1.170	1.300	1.084	1.133
2nd Resonance	1.325	1.472	1.263	1.317
1st Whooo	1.513	1.668	1.581	1.442
2nd Whooo	1.619	1.758	1.687	1.608
3rd Whooo	1.742	1.865	1.800	1.725
1st Pop	1.791	1.906	1.882	1.767
3rd Resonance	1.824	1.971	1.882	1.808
2nd Pop	1.996	2.126	2.053	1.992
4th Resonance	2.020	2.159	2.094	2.050
1st Snore	4.310	5.398	5.200	4.908
2nd Snore	4.367	5.471	5.250	4.858
1st Flop	4.416	5.512	5.307	4.908
2nd Flop	4.449	5.578	5.372	4.958
3rd Flop	4.482	5.627	5.470	5.000

Table 3—Time intervals among the 16 strutting elements of a master, a dominant, and an outsider cock of the Strawberry Valley. Data given in seconds. One sequence per cock class.

	Master	Dominant	Outsider
1st Wing swish	0.000	0.000	0.000
1st Resonance	0.633	0.123	0.294
2nd Wing swish	1.411	0.736	1.284
2nd Resonance	1.623	0.858	1.562
1st Whooo	1.774	1.382	1.693
2nd Whooo	1.874	1.472	1.807
3rd Whooo	2.006	1.595	1.930
1st Pop	2.063	1.652	1.963
3rd Resonance	2.078	1.677	1.987
2nd Pop	2.250	1.848	2.159
4th Resonance	2.273	1.873	2.200
1st Snore	4.750	4.934	5.081
2nd Snore	4.810	4.975	5.122
1st Flop	4.866	5.007	5.163
2nd Flop	4.920	5.057	5.196
3rd Flop	4.976	5.114	5.245

5.144 seconds. This compares to 5.117 seconds for the Strawberry Valley population. These two means were not significantly different ($p \leq 0.05$). If we had ended the strutting sequence at the second pop the length would be 2.042 seconds for the Parker Mountains birds versus 2.086 seconds for the Strawberry Valley birds. These means were also not significantly different ($p \leq 0.05$).

Our data, while showing variation in the time intervals of the strutting sequence, showed no difference among the two populations. Barber (1991) reported

that the Parker Mountains sage grouse had a significantly longer strutting sequence than the other four populations he studied. Although later in the Barber (1991) report, he noted that one of the Parker Mountains birds performed three wing swishes instead of the usual two. He further stated, "If this bird had not been included in the analysis, no significance would have been detected."

The number of steps taken during the strut in our study is given in table 4. Mean number of steps for the Strawberry Valley birds was 5.44 compared to 5.52 for the Parker Mountains birds. Means were not significantly different ($p \leq 0.05$). However, Barber (1991) reported the mean number of steps for the Parker Mountains birds to be 6.56. Scott (1942) reported, "He advances three or four steps, making approximately a one-quarter or one-third turn." We also noted the one-quarter or one-third turn. The difference in number of steps taken among the studies is unknown. Our study indicates that the two populations are similar.

We watched carefully on video tape the movement and positioning of wings, keel, back, head, tail, and feet during the entire strutting sequence; both at normal and slow speeds. Our inspection of video and still pictures of the two strutting population revealed no obvious differences in posturing. Figure 3 illustrates the posturing similarity of the two populations. Further, these pictures compare very well with published pictures of strutting sage grouse in Wyoming (Scott 1942), Montana (Wallestad 1975), and pictures of Wiley (1978), Autenrieth (1986), and Drew (1994—with the exception of the Gunnison Colorado birds).

Coloration of the two populations appears to be similar.

Table 4—Number of steps taken during the strutting sequence of the master and four dominant cocks from the Strawberry Valley and Parker Mountains. Data given as number of steps per sequence; ten sequences per cock class.

	Strawberry Valley										Mean
	1	2	3	4	5	6	7	8	9	10	
Master	5	5	6	6	5	5	6	5	6	6	5.5
Dominant	6	6	4	6	5	6	6	6	5	4	5.4
Dominant	7	6	6	6	4	6	6	6	6	6	5.9
Dominant	6	5	5	4	6	6	6	4	5	6	5.3
Dominant	5	4	5	5	5	5	5	4	6	6	5.1
	Parker Mountains										Mean
	1	2	3	4	5	6	7	8	9	10	
Master	5	5	5	6	5	6	5	5	6	6	5.4
Dominant	6	5	6	5	6	6	5	5	6	6	5.6
Dominant	6	7	6	6	6	5	5	5	6	5	5.7
Dominant	7	5	5	5	5	5	6	6	5	6	5.5
Dominant	5	6	6	7	4	5	6	5	5	5	5.4

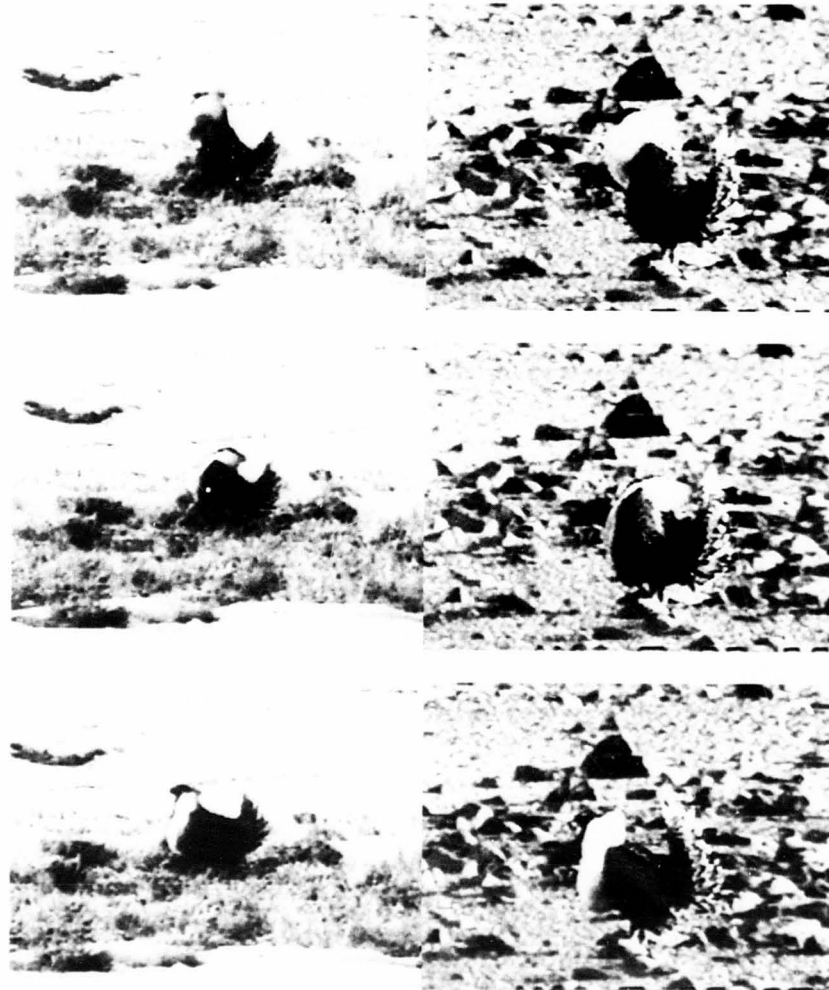
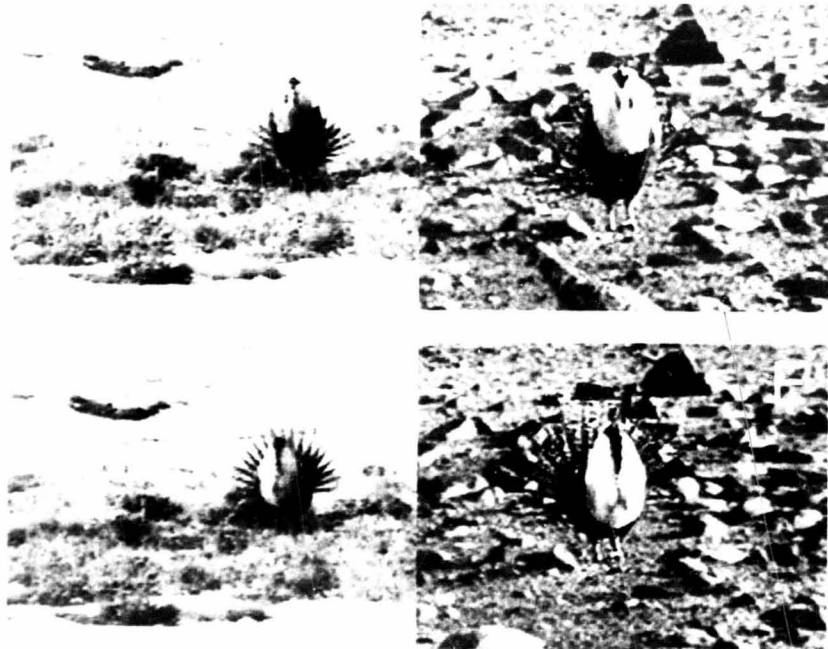


Figure 3—The posturing of male sage grouse from two different populations during strut. Males from the Strawberry Valley are shown on the left with males from the Parker Mountains on the right. Upper case letters are pairs of birds at the same point in the strutting sequence. (Photos were generated by computer from video tapes.)



Conclusions

We concluded from the data collected in this study that the Parker Mountains sage grouse population is suitable in terms of breeding display behavior and coloration to augment the Strawberry Valley population. However, sexual compatibility between the two populations would need to be determined in future studies.

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Sound and video tape recordings and still pictures were taken of two populations of strutting male sage grouse (*Centrocercus urophasianus*). The two populations studied were from the Strawberry Valley and Parker Mountains. Sixteen elements of sounds were identified in the strutting sequence. These elements were the same for both populations. Video tape and still picture analysis revealed that both populations were similar in posturing during the strutting sequence. We concluded that the Parker Mountains sage grouse population is suitable in terms of breeding display behavior to augment the Strawberry Valley population. Sexual compatibility would need to be determined in future studies.

Keywords: *Centrocercus urophasianus*, sonagram, sound print, transplanting



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